A Study on the Effectiveness of Computer Games in Teaching and Learning

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Abstract

Games, especially computer games are becoming one of the tools of education. Nowadays, the usage of computer games as an educational tool has become a worldwide trend. An early assumption suggests that since the appeal of computer games can engage interest and motivation, thus it is a wise step to use computer games for the purpose of educating. This is because students often get bored with the learning process; therefore we need to find creative ways to teach them. Instead of the usual, dull lesson in class, educators are trying out new ways to attract the interest of students to focus the lessons and thus increase their understanding, with one of it using computer games. A lot of papers supported the idea of computer games being effective as an aid for students. Educators alike also agreed that it is one of the ways to gain students interest in their lessons. Before coming to the ultimate conclusion that computer games are a good choice, first of all we need to study carefully the effectiveness of using computer games as an educational medium. This paper aims to study the effectiveness of computer games in learning among students. Issues on the integration of computer games in formal education are and the current status of educational gaming in learning were reviewed in this paper. We focused on higher learning context which is for university students.

Keywords: *Computer Games, Teaching and Learning, Effectiveness of Computer Games*

I. INTRODUCTION

Today, the computer gaming industry has become bigger than the world music and movies industries. Sales of the most popular games are now breaking records for sales of entertainment products. The influence of computer games over the youth of today is akin to that of cultural influence of various fields such as music, personal interest, etc. [1].

Games, especially computer games are becoming one of the tools of education. Many had agreed of its usefulness and effectiveness towards educating students. Instead of the usual, dull lesson in class, educators are trying out new ways to attract the interest of students to focus the lessons and thus increase their understanding, with one of it using computer games. Computer games provide a good environment for learning as agreed by a lot of researchers [2]. There are a lot of questions arise from this issue, mainly about the curiosity on whether computer games are effective to be used as formal education tools as computer games are primarily used as a form of entertainment.

Teachers and educators alike are initiating steps to incorporate computer and video games into learning. Students are found to be feeling motivated to use the game as it is more exciting and interesting rather than just sitting in class and listening to the lecture. By using computer games, students actively participate to solve problems in order to finish a level in the game. With this, we could see that students can learn and practice the lessons through computer games.

This paper explores the effect of using computer games for education in learning among students. In other words, what are the

things that students achieved when they attempt to learn with the aid of educational computer games. The current status of computer games as an educational tool in education level is also evaluated for this paper. The study is also to suggest computer games as a formal educational tool in educations.

The motivation to do this research is based on the current trend of increasing user of computer. Questions like can computer games help students in terms of educations or if it is just solely for entertainment purpose are one of the main motivation for this paper. Since there seems to be a lot of negativity surrounding computer games and how they affect the student's grades badly, it is understandable to find out whether there are any positive sides of computer games and if all types of computer games are suitable for educational purposes.

The significance of this paper is that whether computer games are suitable and effective to be used in education and what type of games are suitable. Some of the related research paper even suggests that computer games to be included in formal teachings in schools and universities.

II. RELATED WORK

There are a lot of games that can be used to serve as learning tools. Strategy games that require internal decision from the gamers and high situational awareness are a common learning games such as chess and Scrabble are very popular in schools to train the student's mind to be active. Virtual simulations and serious games, which are video games that are used for training, advertising, simulation, or education, provide a high level of interactivity not easily captured in traditional teaching/learning environments. Problem-solving games can be used as a practice for students to solve mathematical and real-life problems. A lot of games are also created and designed to train your brain such as Solitaire and crossword puzzle [1].

There are a lot of games designed for the purpose of more formal educational aids for students and for various fields such as mathematics, literature and etc. One of the related works by (Hwang et al, 2011) is ―Chinese Idioms String Up Puzzle game‖ for literature, which is like crossword puzzle, is a text reconstruction online program developed by the Digital Game-Based Learning Laboratory, National Taiwan Normal University in Taiwan, aimed to help motivate students to learn Chinese idioms. This game is intended for users of all ages, not just students [3]. Another game that is to support bilingual education is discussed in a research paper by (Kalemis, 2011) called ―Bilingual Cooperative Intergraded Reading and Composition‖. This game is adapted to meet the needs of limited English Proficient children in bilingual programs who were transitioning from Spanish to English reading [4].

A web-based game that helps students understand mathematical concept of scales are also introduced to elementary students in Taiwan to help them understand maps better. Electronic maps with local districts are designed in which the students are familiar with. By adding characters navigating on the map and solving mathematics problems to reach the goal, this learning system created atmosphere of exploring and learning in fun atmosphere [5].

E-GEMS or the Electronics Games for Education in Mathematics and Science project are introduced by the collaborating teams centred at the University of British Columbia (UBC). The participants for the program are mainly from Queen's University, several schools in British Columbia and Ontario. It managed to produce some guidelines for designing educative computer games as a result from the project. Some of them give accentuation on gender specific criteria, user interface improvements and enabling participants to participate together with their peers as a group [1].

There are also games designed to enlighten students about more humanized issue such as the web game ―His and Her‖, developed in Sweden in 2006 for teenagers that focuses on gender issues. The game even has a teacher manual and their own television developed and it aimed to encourage teenagers to reflect upon gender issues in society and to make players question themselves, their own opinions and behaviour towards others. Since the results were good, they decided to continue using the games for teenagers and keep trying to develop more games [6].

In Malaysia, a study has been conducted on 2011 to test the usability of games using a learning game called "Jelajah" that is designed to teach pre-school children to learn the Malay words. It was developed based on a solid

research on educational approaches. The main purpose is to gather the understanding on children acceptance of a product and how children evaluate whether it is usable, fun and user friendly. The result shows that the level of satisfaction towards the game is high, which shows it is effective [7].

Some issues need to be considers when trying to integrate computer games in education

Incorporating computer games as formal educational tool is not an easy task to be done. There are many considerations to take care of creating computer games and it must be according to specific model of game-based learning to fit for educational purpose. Roger‘s Theory Diffusion of Innovations consists of few characteristics for diffusion in innovation [8]. Learning and games is related by the way games and leaning events happened. Learning with games, through games and by making games are three different kinds of games used in educational system K12. Theory of diffusion consists of five criteria measured during the development of educational games. The criteria involve relative advantage, compatibility, complex ability, trial ability and observe ability. Those criteria will match the purpose of creating educational games but the solution must also outweigh the cost involved.

Traditional method of learning using textbooks and pen-and-pencil approach can be replaced using playing computer games to understand a subject better. Example of application such as programming language games (LOGO), mathematics-solving games (E-GEMS), simulation games for military training (DOOM II), adventure games in corporate environments (SIMS, LIFE), and many more also found in previous research [1]. Paradigms of computer games as a tool of education lies in the interface design, pedagogical knowledge and domain expertise. In the future, gaming world will evolve with the collaboration with technological advance such as artificial intelligence, computer graphics and 3D animations and this will open new possibilities for computer games as a tool for education.

Another concern in making educational computer games is the issues of making the content of the game itself become educational [9]. Creating interactive games is important to determine the success of delivering educational content for students. Thus, to make sure educational computer game to be integrated as formal education, it is important for game designer and developer to get a deep understanding on the purpose to use game as learning tool.

Researchers have proposed several learning style theories and one of it is the Felder-Silverman learning style which has been widely adopted and validated by various studies. In one study [10], two versions of an educational computer game are developed based on the sequential/global dimension of Felder–Silverman‘s learning style theory for investigating the effect of learning styles on student's learning motivation. It is found that students who learned with games that match their learning style had significantly higher motivation than those who learned with games that do not match their learning style.

Moreover, the pre-test and post-test results in this study showed that the learning achievements of the first mentioned group is far better than the latter. It is concluded that if students prefer one game over another, it does not necessarily mean they will learn better with what they have chosen. Hence, it is important to provide individual students with personalized learning content to best benefit them. This finding emphasizes the necessity of considering the learning style of individual students when developing educational systems. Furthermore, it also provides evidence to support the development of adaptive systems.

Another study, investigated the possibilities of optimizing computer games as a pedagogy tool especially focusing at students' social skill development [11]. The study revolved around classroom sessions and activities that involved computer games. The findings in this paper revealed that students were more communicative among themselves and willing to work in groups. However, it is important that these students are divided according to their intelligence level. Students work best with those they are comfortable with and have the same level par of intelligence. The main issue is not what instrument or technology is used for teaching and learning, instead it is how it is applied and diffused.

Teachers have to be proactive to make sure that these computer games are incorporated effectively for the sake of students' social skills development i.e. selecting students and dividing them accordingly based on their capabilities and intelligence. This paper gives the idea that with

properly chosen computer games, educational practitioners can use gaming within learning environments.

There are many challenging subjects students have to face, for example programming. Therefore it is important to investigate how educational games help to improve students learning attitude. A study discussed the perception of students towards using educational games as a learning medium for programming [12]. In the findings, students showed high motivation in using the game and they believe games make the subject fun and interesting as well. Students also interested in playing educational computer games related to their studies in order to understand the subject better in effective learning style. Other than that, games promoted their cognitive development such as critical thinking and challenged their understanding about the subject.

III. RESEARCH METHODOLOGY

This research uses quantitative study, also called descriptive quantitative research as we are focusing on the study of the effectiveness of computer games on learning for students. The use of computer games in studies may affect students in various ways. The behaviour of students towards using computer games is observed in the research. Other than that, student‘s behaviour will be quantified in our research.

The research is conducted using survey research techniques. In the survey, questionnaire is formed appropriately based on research objectives. The questionnaire construction is done in proper way and using technology available to create online questionnaire in Internet which is free and easy to use rather than distributing the question by hand. Online survey created with Google Docs will be used. From the survey, 40 sets of questions are expected to be answered by students from Universiti Sains Malaysia, Penang. Data collected will be tabulated and analysed.

Quantitative research method is used as the focus of this paper is to study the effects of using computer games on students. Students mostly play computer games and a lot of characteristics can be described throughout survey and observations. We set the population for the research which are the students at Universiti Sains Malaysia, Penang.

Diverse area of study among students will affect the survey as humans psychologies are wide to be explored. Non probability sampling of respondent is used to sample research data. The sampling form that we would use is convenience sampling where any first 40 students that help answering the questionnaire will be chosen. Based on their answer, the characteristics that they had during their experience on using computer game is known later.

IV ANALYSIS AND FINDING

A survey was done to get information about learning behaviours using computer games on students in Universiti Sains Malaysia, Penang, Malaysia. About 40 respondent responses were collected and analyzed for this research.

From the result, there are 15 students (38%) that play games when they are feeling bored. Students feeling bored when there are not interested in doing or listening to something. While studying alone, reading books, doing exercises and other related activity can cause high possibility of their studies faded away. Thus, games can be used to make the content of specific subject fun and interesting. One university that were using games to replace pen and pencil approach of doing exercise in a course in Computer Fundamentals in 2003 at Norwegian University of Science and Technology (NTNU), Trondheim, Norway named Age of Computer (AoC) [13]. From AoC experimental results, it is reasonable to assume the game can give a lot of contribution in learning the course. In this case, students were playing games as suggested by their lecturer and give good response on evaluations for the game. Students were encouraged to do exercises and they understand the subjects better compared to only reading references.

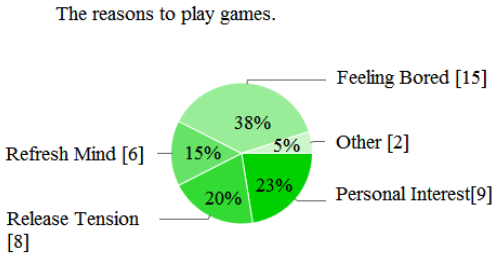

Figure 1. Reason for Playing Computer Games

Figure 1 shows the pie chart of respondents answer on the questions about the reasons they play computer game on their own without being asked by anyone. This shows that computer games are well liked by students. Thus, by giving students the opportunity to play whilst studying will make them feel eager to study.

Computer game can be another option for students to study as computer games can be effective in many ways. Technologies nowadays has made people more attracted to activities involving simulations, web-based applications, online video games and other applications that are available in the markets. Today, people would browse through any information in the Internet rather than traditional method of learning or looking through piles of books when digging information that they required. It is the same for students in newer generation that would choose to study using high technology method and in this case using computer game.

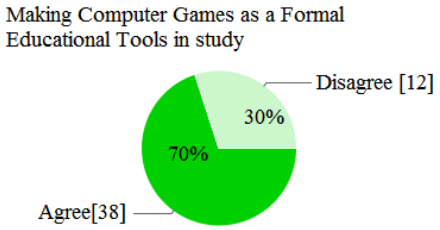

Figure 2: Respondents opinion on issues of computer games as formal educational tool is study.

Based on Figure 2, it clearly shows that students would agree with the idea of incorporating computer game as a formal educational tool in studies. In response for the questions, computer game is another alternative to teach with the use of images, animations, colourful texts, sounds and other elements in computer games. Those elements can be combined together and give an excitement to learn more in the subject matter. Computer game would affect student learning abilities when their brain stimulates response by playing it. Playing games would give benefits in social and emotional developments [14].

Social development can be nurtured by engaging students in a suitable gaming environment. As for the real-world context, students would learn how to apply the strategies and techniques learnt from the characters of the simulation game while playing it. The game's content would consist of characters which is the representative of the player. In the process of problem-solving, the characters would have to pass through many stages to complete the mission and win the game. In order to win, students would be motivated to finish their mission first. In the end of the game, they have already developing problem-solving skills.

In the other hand, by playing educational games students would instill the emotional development within themselves as the process of completing a game mission required stable emotions to be able to solve the problem exists in the games. If player where in a bad shape at the moment, their results would not be excellent. Player would feel excited at the beginning of playing game, curiosity increase and then the excitement would be different till they feel relieved at the end. Emotion would change according to the situation that they encounter at the moment. In educational game, students would understand the heart of the problem in of that game and while understanding the problem, they would get to know better the educational content inside it. Effectively, they would not feel burdensome to understand the content in the game compared to understand the same content in classroom.

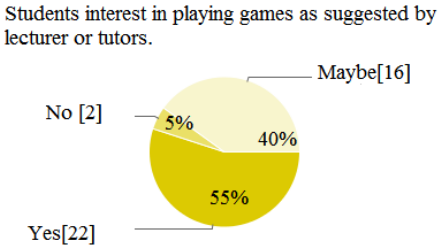

Figure 3: Respondents interest on playing games as suggested.

Figure 3 shows 22 respondents (55%) say "Yes" to consider playing game that is suggested by their lecturer that is related to their studies. Another 16 respondents (40%) answered "Maybe" as they are not really sure whether to play game that is suggested. We can say that students are not really interested in playing unfamiliar games that they do not know.

We also found that reference books are still the main option in studies. The idea of using games to replace books involved long agreement to go on with. We do not have clear description on the game perspective in learning. The main purpose of games that is widely known is only

for fun. Thus, for learning purpose, we need to be exposed to educational gaming or also known edutainment. At early stage, edutainment works on children as their childhood development can be enhances with the help of games. However, at student‘s level, gaming for a specific or subject would be hard to be implemented and is still not widely known in universities in Malaysia.

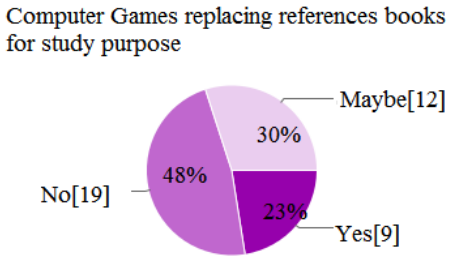

Figure 4: Respondents opinion on the issue of replacing references books for study.

Figure 4 above shows majority of our respondents do not agree with the use of computer games to replace main references which is books. They still choose traditional ways to studies. None of our respondent had the experience of playing games that is related to their subject matter. The answer may change if any games had been developed in their studies.

We conclude our findings with the effectiveness of computer games in learning actually can be expressed as the way a player deals with the games itself. People think differently from each other. Thus, their personal development that mentioned earlier may vary. One of the skills that can be developed by playing games especially educational games is problem-solving skills and other skills may be developed eventually as time goes by.

V. CONCLUSIONS

The effects of using computer games for education in learning among students are their learning motivation have increased. The possibilities of optimizing computer games as pedagogy tool especially focusing at students' social skill development are also found. Computer games also promoted their cognitive development such as critical thinking and challenged their understanding about the subject. Social and emotional development can be nurtured by engaging students in a suitable gaming environment. Based on related works, there are a lot of established educational computer games that are being used by educators. Some countries have even accepted computer games as a formal tool of education, for example Sweden that even allowed the game "His and Hers" to be adapted as television shows. Therefore, we suggest that computer games are suitable to be used as formal educational tools while reference books are still the main option in studies as preferred by students and educators.

For future works, we would like to further study the elements that make computer games a preference for educators and the types of games that is the most suitable to be used as an educational tool. We would also like to develop a framework for educational computer games that will be used in specific course in universities. We hope that people‘s perception towards computer games become more positive as it has its own benefits in learning.

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